

AMENDMENTS TO THE CLAIMS

Claims 1-15 have been canceled.

16. (New) A multicarrier radio communication system comprising:

a first communication device that transmits a signal and includes

a transmitting antenna for each channel;

a by-channel known-signal generating unit that generates known signals by channels, the known signals being spread by a code orthogonal between channels;

a common known-signal generating unit that generates a common known signal that is common to the channels; and

a transmission-signal generating unit for each channel that generates a transmission signal for a corresponding channel by allocating user data, the common known signal, and the known signals by channels according to a prescribed frame format, the transmission signal being a signal to be transmitted via corresponding antenna; and

a second communication device that receives the signal from the first communication device and includes

a receiving antenna for each channel;

an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using the common known signal; and

a by-channel known-signal extracting unit that extracts the known signals by channels from a reception signal for each channel, which is a signal received via the receiving antenna, after establishing the timing synchronization.

17. (New) The multicarrier radio communication system according to claim 16, wherein the second communication device further includes

a despreading unit that despreads the reception signal with the orthogonal code based on information concerning the timing synchronization;

a matched filtering unit that calculates channel impulse responses by channels from the signal that is despreaded; and

a preceding-wave searching unit that determines a preceding wave position based on the channel impulse responses, and

the by-channel known signal extracting unit extracts the known signals by channels based on the preceding wave position.

18. (New) A multicarrier radio communication system comprising:

a first communication device that transmits a signal and includes

a transmitting antenna for each channel;

a by-channel known-signal generating unit that generates known signals by channels, the known signals being spread by a code orthogonal between channels;

a same-period known-signal generating unit that generates a same-period known signal, which is a repetition signal with a period that is same among the channels; and

a transmission-signal generating unit for each channel that generates a transmission signal for a corresponding channel by allocating user data, the same-period known signal, and the known signals by channels according to a prescribed frame format, the transmission signal being a signal to be transmitted via corresponding antenna; and

a second communication device that receives the signal from the first communication device and includes

a receiving antenna for each channel;

an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using the same-period known-signal; and

a by-channel known-signal extracting unit that extracts the known signals by channels from a reception signal for each channel, which is a signal received via the receiving antenna, after establishing the timing synchronization.

19. (New) The multicarrier radio communication system according to claim 18, wherein the second communication device further includes

a despreading unit that despreads the reception signal with the orthogonal code based on information concerning the timing synchronization;

a matched filtering unit that calculates channel impulse responses by channels from the signal that is despreaded; and

a preceding-wave searching unit that determines a preceding wave position based on the channel impulse responses, and

the by-channel known signal extracting unit extracts the known signals by channels based on the preceding wave position.

20. (New) A multicarrier radio communication system comprising:

a first communication device that transmits a signal and includes

a transmitting antenna for each channel;

a by-channel known-signal generating unit that generates known signals by channels, the known signals being spread by a code orthogonal between channels;

a same-period known-signal generating unit for each channel that copies corresponding known signal for corresponding channel, and generates a same-period known signal, which is a repetition signal with a period that is same among the channels and is configured by a plurality of the same known signals by channels which are copied; and

a transmission-signal generating unit for each channel that generates a transmission signal for a corresponding channel by allocating user data, the same-period known signal, and the known signals by channels according to a prescribed frame format, the transmission signal being a signal to be transmitted via corresponding antenna; and

a second communication device that receives the signal from the first communication device and includes

a receiving antenna for each channel;

an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using the same-period known signal; and

a by-channel known-signal extracting unit that extracts the known signals by channels from a reception signal for each channel, which is a signal received via the receiving antenna, after establishing the timing synchronization.

21. (New) The multicarrier radio communication system according to claim 20, wherein the second communication device further includes

a despreading unit that despreads the reception signal with the orthogonal code based on information concerning the timing synchronization;

a matched filtering unit that calculates channel impulse responses by channels from the signal that is despreaded; and

a preceding-wave searching unit that determines a preceding wave position based on the channel impulse responses, and

the by-channel known signal extracting unit extracts the known signals by channels based on the preceding wave position.

22. (New) A communication device for transmitting a signal comprising:

a transmitting antenna for each channel;

a by-channel known-signal generating unit that generates known signals by channels, the known signals being spread by a code orthogonal between channels;

a common known-signal generating unit that generates a common known signal that is common to the channels; and

a transmission-signal generating unit for each channel that generates a transmission signal for a corresponding channel by allocating user data, the common known signal, and the known signals by channels according to a prescribed frame format, the transmission signal being a signal to be transmitted via corresponding antenna.

23. (New) A communication device for transmitting a signal comprising:

a transmitting antenna for each channel;

a by-channel known-signal generating unit that generates known signals by channels, the known signals being spread by a code orthogonal between channels;

a same-period known-signal generating unit that generates a same-period known signal, which is a repetition signal with a period that is same among the channels; and

a transmission-signal generating unit for each channel that generates a transmission signal for a corresponding channel by allocating user data, the common known signal, and the known signals by channels according to a prescribed frame format, the transmission signal being a signal to be transmitted via corresponding antenna.

24. (New) A communication device for transmitting a signal comprising:

a transmitting antenna for each channel;

a by-channel known-signal generating unit that generates known signals by channels, the known signals being spread by a code orthogonal between channels;

a same-period known-signal generating unit for each channel that copies corresponding known signal for corresponding channel, and generates a same-period known signal, which is a repetition signal with a period that is same among the channels and is configured by a plurality of the same known signals by channels which are copied; and

a transmission-signal generating unit for each channel that generates a transmission signal for a corresponding channel by allocating user data, the common known signal, and the known signals by channels according to a prescribed frame format, the transmission signal being a signal to be transmitted via corresponding antenna.

25. (New) A communication device for receiving a signal comprising:
- a receiving antenna for each channel;
 - an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using a common known signal that are common among channels; and
 - a by-channel known-signal extracting unit that extracts known signals that is spread by a code orthogonal between the channels, by channels, from a reception signal for each channel, which is a signal received via the receiving antenna, after establishing the timing synchronization.
26. (New) The communication device according to claim 25, further comprising:
- a despreading unit that despreads the reception signal with the orthogonal code based on information concerning the timing synchronization;
 - a matched filtering unit that calculates channel impulse responses by channels from the signal that is despreaded; and
 - a preceding-wave searching unit that determines a preceding wave position based on the channel impulse responses, and
 - the by-channel known signal extracting unit extracts the known signals by channels based on the preceding wave position.
27. (New) A communication device for receiving a signal comprising:
- a receiving antenna for each channel;

an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using a same-period known signal, which is a repetition signal with a period that is same among channels; and

a by-channel known-signal extracting unit that extracts known signals that is spread by a code orthogonal between channels, by channels, a reception signal for each channel, which is a signal received via the receiving antenna, after establishing the timing synchronization.

28. (New) The communication device according to claim 27, further comprising:

a despreading unit that despreads the reception signal with the orthogonal code based on information concerning the timing synchronization;

a matched filtering unit that calculates channel impulse responses by channels from the signal that is despreaded; and

a preceding-wave searching unit that determines a preceding wave position based on the channel impulse responses, and

the by-channel known signal extracting unit extracts the known signals by channels based on the preceding wave position.

29. (New) A communication device for receiving a signal comprising:

a receiving antenna for each channel;

an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using a same-period known signal, which is a repetition signal with a period that is same among channels and is configured by a plurality of same known signals by channels; and

a by-channel known-signal extracting unit that extracts known signals that is spread by a code orthogonal between channels, by channels, from a reception signal for each channel, which is a signal received via the receiving antenna, after establishing the timing synchronization.

30. (New) The communication device according to claim 29, further comprising:

a despreading unit that despreads the reception signal with the orthogonal code based on information concerning the timing synchronization;

a matched filtering unit that calculates channel impulse responses by channels from the signal that is despreaded; and

a preceding-wave searching unit that determines a preceding wave position based on the channel impulse responses, and

the by-channel known signal extracting unit extracts the known signals by channels based on the preceding wave position.